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Tunable Relativistic Infrared Pulses from Laser-produced Wakes in Tailored Plasma Structures ZAN NIE, University of California, Los Angeles, CHIH-HAO PAI, JIE ZHANG, XIAONAN NING, JIANFEI HUA, WEI LU, Tsinghua University, HSU-HSIN CHU, JYHPYNG WANG, National Central University, CHAOJIE ZHANG, WARREN MORI, CHAN JOSHI, University of California, Los Angeles — The development of intense few-cycle mid-infrared (mid-IR, λ<5 μm) laser sources has made significant progress during the past decade, which has opened many opportunities for infrared nonlinear optics, high-harmonic generation and pump-probe experiments in the "molecular fingerprint" region. However, even longer carrier wavelength (˜10 μm) are needed in many applications. It is one of the current challenges facing ultrafast laser technology to generate high-energy, ultra-short long-wave IR (LWIR) pulses, beyond the capability of existing methods. Recently, a new scheme that utilizes asymmetric self-phase modulation (SPM) in a tailored plasma density structure to generate multi-millijoule energy, single-cycle LWIR pulses tunable in a wide spectral range was proposed. Here, we experimentally demonstrate this novel scheme for the first time. An intense single-cycle IR pulse with a central wavelength of 9.4 μm and energy of 3.4 mJ is generated using a ˜580 mJ, 36 fs, 810 nm drive laser. Furthermore, the tunability of the IR wavelength in the range of 3-20 μm is also demonstrated through simple adjustment of the plasma structure.

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